Responsiveness of Output & Prices to Monetary & Fiscal Shocks in India

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The present study examines the impact of expansionary monetary and fiscal policies on the output gap, price level and real effective exchange rate in India during 2001:M4 to 2018:M7 using sign restricted Bayesian Vector Autoregressive modelling. Innovation accounting analysis indicates the fiscal dominance in India as fiscal policy intervention causes higher variations than monetary policy in output gap, price level and exchange rate. Since fiscal policy impulse does not have any significant impact on output gap, it has been observed that monetary policy is more effective than fiscal policy to target all the key variables in the Indian context. The study also finds that expansionary fiscal policy was followed by contractionary monetary policy by the Reserve Bank of India.

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Introduction

Monetary and fiscal policies are the two most central stabilisation tools in the economy having strong theoretical background. Since Classicals, large number of theories can be observed on the implementation and effectiveness of these two macroeconomic policies. Classicals firmly believed in full employment and argued that markets cleared on their own. But according to Keynes, less than full employment is a normal feature of the economy. During the Great Depression of 1930s, markets failed to get cleared and there was demand deficient unemployment in the economy. Keynes had suggested government intervention to overcome this problem of mass unemployment. There is downward inflexibility of wages that averts the clearing of markets (Miller & Pulsinelli, 1986). The crux of Keynesian economics is that it is the fiscal policy which plays a major role in the recession. Keynesians believe that during recession and unemployment, increase in aggregate demand does not cause inflation. It enhances the real output in the economy (Mankiw, 2007). Monetarism had called into question the Keynesian economics and its views are quite similar to those of the Classicals. In their opin-

ion, aggregate supply curve is inelastic in the long run. If aggregate demand is more than aggregate supply, it may lead to increase in real output during short periods. But over a long period of time, output will revert back to the original level of real GDP and higher inflation in the economy. In this way, monetarists show the ineffectiveness of fiscal policy in the long run. Neo-classicals like Robert Lucas believe that people are quite rational and can anticipate policies. Their rational expectations lead to ineffectiveness of anticipatory monetary as well as fiscal polieies (Mukherjee, 2009). Neo-Keynesians like N.G. Mankiw and David Romer believe that automatic adjustment is not possible due to the presence of wage and price rigidities in the economy (Gordon, 2011). Although people have rational expectations, monetary policy will be effective in stabilizing the economy. Due to the existence of rigidities and gradual price adjustments in an economy, anticipated monetary policy has its effects on real variables like output and employment in the short run.

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Review of Literature

Given the theoretical views in support of monetary and fiscal policies, let us have a look on the noteworthy contributions that have measured the effectiveness of macroeconomic policies all over the globe. Rangarajan and Arif (1990) analysed the linkages between money, output and prices from 1961-62 to 1984-85 in the Indian context. The study found that increase in money supply leads to increase in price levels more than output. If government expenditure exceeds government revenue, it results in widened resource gap and impacts the price level in the economy. When government increases capital expenditure, its impact on prices and output is a function of the resource gap financed by borrowings from the RBI. The trade-off between price level and output worsens with increase in borrowings from the RBI. Dixit (2001) examined the interaction of fiscal and monetary policies in European Monetary Union countries. Fiscal policies rather than discretionary monetary policy should start the game to receive higher payoff for European Central Bank. Spillover effects of productivity shocks in one country can be enjoyed by other countries too. Fiscal constraints are required for the monetary commitment. The more the fiscal freedom, the less the monetary commitment is. Parida et al. (2001) explored the linkages between fiscal deficit, money supply and price level from 1960-61 to 1999-2000 in India. The study showed that both money supply and fiscal deficits impact the price level, but price level impacts neither the fiscal deficits nor the money supply. Therefore, rising inflation does not provoke high fiscal deficits; whereas monetization of deficits is one of the major causes of inflation in India. Chadha and Nolan (2007) examined through a micro-founded model that stabilization requires

interaction of both fiscal and monetary policies in the USA and UK. When monetary policy is targeting inflation, fiscal policy should target output systematically so that automatic stabilizers can play their role in the optimal policy. Mikek (2008) investigated the role of fiscal policy in new member states (NMS) of European Union when monetary policy is targeting inflation and exchange rate stabilization. Even restrictive monetary policy leads to higher inflation if fiscal policy is expansionary. To stabilize the inflation and exchange rate, sustainable fiscal policy is required in open economies of NMS. Khundrakpam and Goyal (2009) analysed the relationship between money, price, government deficit and real output in India over the period of 1951-52 to 2006-07. The study found that both the real output and money have an impact on prices in the short as well as long runs. Government deficit is a major factor in the growth of money supply through the creation of reserve money; thus, it raises the price level in the economy. On the other hand, increase in real output leads to reduction in the price level. Money has no impact on real output both in the short as well as long runs and fiscal consolidation continuously remains too essential to stabilise the economy. Khundrakpam and Pattanaik (2010) estimated the linkages between fiscal deficit and inflation in India over the period 1953-2009. The study analyzed that one percent point addition in the level of fiscal deficit can raise the Wholesale Price Index (WPI) by about 0.25% point. Fiscal deficit determines the price level and vice-versa is not true. Davig and Leeper (2011) analyzed how active and passive monetary and fiscal policies switched in the United States from 1949: Q1 to 2008: Q4. Irrespective of monetary-fiscal regime, increase in government spending leads to increase in demand for goods, which further increases the demand for labor. Prasanna and Gopakumar (2011) analysed the relationship between GDP growth and inflation over the period 1972-2008 in India using cointegration and Error Correction models. The study noticed the positive relationship between GDP growth and inflation in the short run. There exists trade-off between lower inflation and higher growth and both cannot be achieved simultaneously. The sensitivity of growth to changes in inflation rates is smaller than that of inflation to variations in growth rates. Prabhakar & Mahadevan (2016) analyse the relationship between Gross Domestic Product (GDP) and WPI measure of inflation from 2000-01 to 2013-14 in India using Ordinary Least Squares (OLS) regression technique. The study regresses Wholesale Price Index on GDP and coefficient of GDP is found to be positive but not statistically significant. Positive coefficient of GDP shows that increase in growth, measured by GDP leads to rise in the inflation rate in the economy. The study suggested that RBI and government should check the rising price levels in the economy through the implementation of recommendations of Urjit Patel Committee (2014) to sustain economic growth.

Having observed literature, keeping in view the key variables of macroeconomic policies, this paper attempts to examine the effectiveness of monetary and fiscal policies in India using Sign re-

stricted Bayesian Vector Autoregressive (BVAR) modelling.

Data & Construction of Variables

The present research is based on the secondary data of the Indian economy from the period of 2001:M4 to 2018:M7. The sources of the monthly time series data used in the present study are: Call Money Rate (CMR), Gross Fiscal Deficit (GFD) and Real Effective Exchange Rate ($REER$) have been collected from the Handbook of Statistics on the Indian Economy, a RBI publication covering the period of April 2001 to July 2018. Besides, data on Wholesale Price Index (WPI) and Index of Industrial Production (IIP) have been extracted from International Financial Statistics Database, an International Monetary Fund publication over the period of April 2001 to July 2018. The key reason for the selection of the time period from 2001 onwards is that Repo Rate (RR) and Reverse Repo Rate (RRR) had been introduced in India in 2001 only. Since RR and RRR are among the most important monetary policy rates in Indian context, the structure of interest rate channel of monetary policy transmission mechanism in India has altered completely with their introduction.

The WPI series have been used to indicate the inflation rate, while, IIP has been engaged as a proxy variable for Gross Domestic Product (GDP) because of the unavailability of monthly data on GDP in India. Moreover, employing IIP, output gap (OG) is computed with Hodrick-Prescott (HP) filter (Raj et al., 2011). Following Grigoli et al. (2015) and Kawamoto et al. (2017), OG is defined as percentage deviation of actual output (Y_t) from trend output (Y_t^*) and measured using the following formula:

$$OG = \left(\frac{Y_t - Y_t^*}{Y_t^*} \right) \times 100$$

The GFD series have been transformed into logarithmic form; whereas following Besimi et al. (2006), CMR and OG are transformed as:

$$\left(1 + \frac{Value\ of\ Variable\ in\ Period\ t}{100} \right) \times 100$$

Hence, the coefficient of logged values measures constant elasticity while the coefficients of *CMR* and *OG* will depict the percentage changes of the dependent variables in response to a one point percentage change in these variables, respectively.

Methodology

Time series data is a set of values occupied by a variable disciplined in time such as annually, quarterly and monthly etc. It often has the problems of non-stationarity and seasonality etc. A time series data is said to be stationary, if it's mean, variance and auto-covariance remain constant over a period of time (Gujarati, 2003). To remove the problem of non-stationarity, it is required to find out the order of integration (i.e., at which non- stationary time series variables become stationary) of time series variables. As suggested in literature, in the present study, stationarity has been checked on the basis of Augmented Dickey-Fuller (ADF) test with drift and time trend, with

drift only and without drift and time trend to point out the presence of unit root and order of integration. As exposed in Table 1, *OG, CMR* and *REER* are integrated at order zero, while *WPI* and Log gross fiscal deficit *(LGFD)* are integrated at order one respectively.

Table 1 Unit-root Testing

Variable	Decision
OG	*I(0)*
WPI	*I(1)*
REER	*I(0)*
CMR	*I(0)*
LGFD	*I(1)*

Note: *I(0)* and *I(1)* represent integrated of order zero and integrated of order one respectively.
Source: Authors' Calculations

All the variables are required to be stationary (i.e. integrated at order zero) to estimate the VAR model. However, as depicted in Table 1, this is not the case with the component variables in the study. Therefore, Bayesian VAR has been estimated to conduct the present research as it is free from the problem of the order of integration of the variables, seasonality and structural break issues (Fanchon & Wendel, 1992).

Sign Restricted Bayesian VAR Model

Here, it is explained in brief how the Vector Autoregressive model (VAR) is different from Sign restricted Bayesian Vector Autoregressive model. In Vector Autoregressive model (VAR), there is no exogenous variable and each endogenous variable is dependent on its own past values as well as the past values of all other endogenous variables in the model. Innovation analysis in VAR modelling is the outcome of uncorrelated shocks to a particular variable on other component variables in the model and has been carried out by imposing identification restrictions. But these identification restrictions are not based on the economic theory in VAR modelling, which is the major drawback of this model (Kumar, 2018). On the other hand, in sign restricted models, identification restrictions take into consideration the economic theory. Bayesian VAR models overcome the problem of overfitting by narrowing down the numerous parameters (Ciccarelli & Rebucci, 2003). Moreover, VAR models have been associated with only positive impulses (shocks), but in the present scenario, negative shock of interest rate is needed to exercise the expansionary monetary policy. That is why, sign restricted Bayesian VAR methodology has been chosen over VAR model. Having explained this, following Ciccarelli & Rebucci (2003) and Uhlig (2005), Sign restricted Bayesian Vector Autoregressive Model has been estimated with optimum lag length $p=12$ in this paper to study the impact of expansionary monetary and expansionary fiscal policies on output gap, interest rate, fiscal deficit, inflation rate and real effective exchange rate in the context of India.

The studies by Uhlig (2005), Franta (2011), Jääskelä and Smith (2011), Adler & Buitron (2017), Mangadi and Sheen (2017) and Arora (2018) have estimated sign restricted models to examine the relations of macroeconomic policies. According to Jääskelä and Smith (2011), sign restriction methodology is "placing

Sign restriction methodology is "placing restrictions on the direction that variables will move over a given horizon, in response to different types of shocks".

restrictions on the direction that variables will move over a given horizon, in response to different types of shocks". All the shocks are assumed to be uncorrelated and signs of accumulated impulse responses have been restricted in particular direction (Mangadi & Sheen, 2017). In this paper, negative sign restriction on interest rate (i.e., expansionary monetary policy) and positive sign restriction on fiscal deficit (i.e., expansionary fiscal policy) are the two policy shocks that have been given to analyze the impact of cheap macroeconomic policies on various component variables like output gap, interest rate, fiscal deficit, inflation rate and real effective exchange rate in India. Uhlig (2005)'s sign restriction methodology has been adopted to identify these policy shocks using *VARsignR* package built by Danne (2015) in *R* statistical package.

Empirical Analysis with Sign-Restricted Bayesian VAR Model

Impulse response functions and variance decomposition functions are the two tools under which innovation accounting analysis has been carried out. Innovation accounting analysis investigates the response of the target variables (output gap, interest rate, fiscal deficit, price level and real effective exchange rate) as a result of a shock to the particular variable (negative interest rate shock or positive fiscal deficit shock) over a period of time.

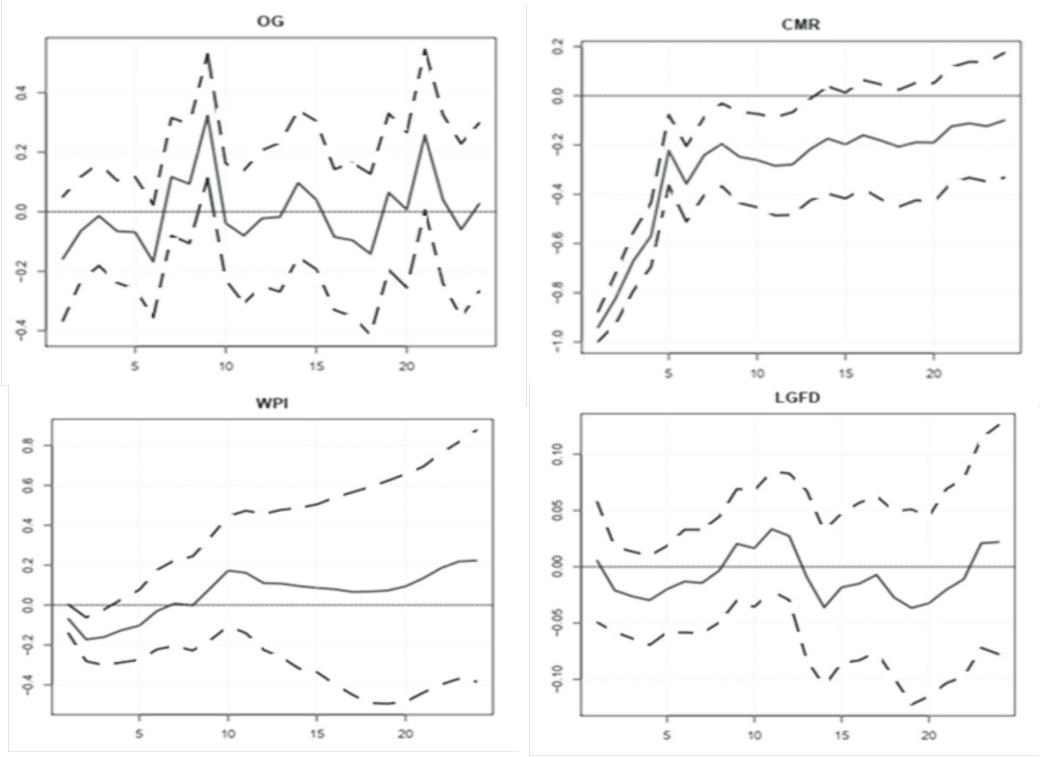
Impulse Response Functions

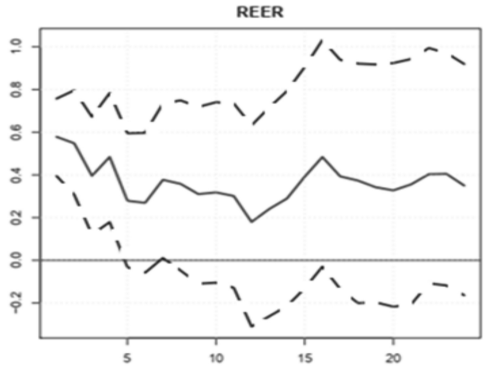
The impulse response functions exhibit how one variable changes dynamically because of one standard deviation shock to other component variable in the model. If the confidence bands (dotted lines) have any contact with the zero line in the figure, the impulse response function is said to be a significant one and vice-versa. A time span of twenty months has been taken to analyze the dynamic variation in the path of a variable due to a monetary and fiscal shock individually. Fig. 1 demonstrates the dynamic impulse responses (dark line) of OG, WPI, $LGFD$ and $REER$ to the negative shock to monetary policy (i.e., reduction in CMR). In fig. 1, negative shock to the interest rate (i.e, *CMR* is keeping it in the negative zone (below the zero line). The interest rate shock has been restrained negative for three months only because monetary policy has been announced on quarterly basis in India until the year 2016. Since sample period is dominated by pre 2016 era hence the quarterly review has been preferred. It has been noticed that the significant impact of expansionary monetary policy on *OG* is initially negative for six months. The positive impact of expansionary monetary policy on *OG* can be seen with the lag of six months in the Indian context. Output gap is the difference between potential output and actual output and hence highlights the state of the demand for goods and services in the economy (Jahan & Mahmud, 2013).

Therefore, cheap monetary policy enhances the demand for goods and services in India after six months. It can be visualised in fig. 1 that dynamic response of price level (i.e.,) e to reduction in is significantly negative for almost seven months. Expansionary monetary policy as expected affects the price level positively with the lag of seven months and after that price level does not approach back towards the equilibrium path. In sum, expansionary monetary policy as a lead indicator increases the demand for goods and services in the economy and hence affects the price level positively. There is no significant impact of expansionary monetary policy on *LGFD* as the confidence bands (dotted lines) of it do not touch the zero line. The response of *REER* is significantly positive over the period of time. It has the support of the theory that there will be higher outflow of foreign capital due to the reduction in domestic interest rate. It will further carry out deterioration in balance of payments (BOP) of the economy and depreciation in exchange rate. Henceforth, the real effective exchange rate will rise (Snowdon & Vane, 2005).

Expansionary monetary policy as a lead indicator increases the demand for goods and services in the economy and hence affects the price level positively.

Fig. 1 Impact of Expansionary Monetary Policy





Source: Authors' elaborations using *VARsignR* package in *R* software

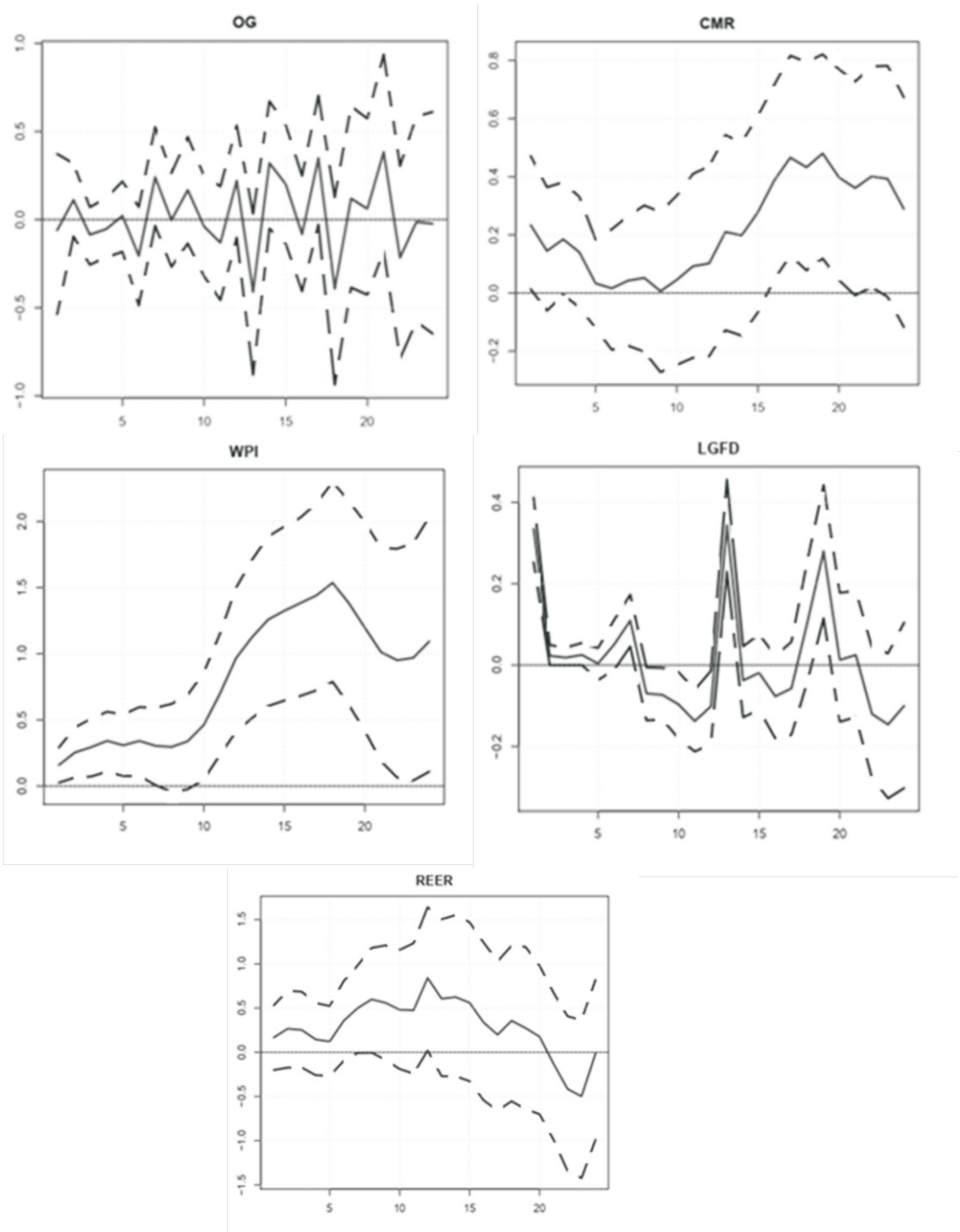
Fig. 2 displays the impulse responses (dark line) of OG, WPI, CMR and $REER$ to the positive shock to fiscal policy (i.e., increase in $LGFD$) over a period of twenty four months. Since, an attempt has been made to do the uniform exercise for both policies; the fiscal deficit shock has also been restrained positive for three months only. In fig. 2, positive shock to the fiscal deficit (i.e, $LGFD$) is keeping it in the positive zone (above the zero line) in the initial months. The price level (i.e., WPI) is significantly positive and attains new equilibrium level due to the expansionary fiscal policy of the government. This policy has enhanced the purchasing capacity of the people either through less taxation or more expenditure. There is no significant impact of expansionary fiscal policy on OG as the confidence bands (dotted lines) of it do not touch the zero line. Here, it can be concluded that expansionary fiscal policy increases aggregate demand by pumping more money in to the economy without significantly enhancing the production capacity and hence creates only inflation in the economy. The impact of positive $LGFD$ on *CMR* is significantly positive which means that monetary authority is keeping check on cheap fiscal policy in India and its effects on inflation rate. Again, the response of *REER* is significantly positive over the period of time. Expansionary fiscal policy leads to the rightward shift of IS curve in Mundell and Flemming model, given the original position of IS-LM-BP curve. The Balance of payment deteriorates at the intersection point of new IS-LM-BP curve and hence real effective exchange rate will increase (Snowdon & Vane, 2005).

Expansionary fiscal policy increases aggregate demand by pumping more money in the economy without significantly enhancing the production capacity and hence creates only inflation in the economy.

Variance Decomposition Functions

The variance decomposition function explains the total variation in a variable due to an exogenous shock to the other component variable in a model. Table 2 illustrates the variance decomposition of the main three target variables (i.e., OG, WPI and $REER$) and two policy variables (i.e., CMR and $LGFD$) explained by monetary policy shock (reduction in interest rate) after a span of twenty four months. The results highlight that the magnitude of the variation explained in $REER$ (18.86 percent) is the

Fig. 2 Impact of Expansionary Fiscal Policy



Source: Authors' elaborations using *VARsignR* package in *R* software

highest among all the remaining four variables due to the interest rate shock. The second highest variation explained is in *OG* to the tune of 9.24 percent, closely followed by *LGFD* (7.65 percent) and *WPI* (7.62 percent) over a period of time.

Table 2 Variance Decomposition Due to a Monetary Policy Shock (Interest Rate Shock)

Period (Months)	Variables				
	OG	WPI	REEP	CMR	LGFD
1	1.15	2.05	14.84	70.74	1.10
2	2.09	2.65	15.02	67.05	1.85
3	2.94	2.94	15.61	65.44	3.37
4	3.58	3.26	15.57	63.04	4.10
5	4.23	3.61	15.89	60.36	4.79
6	5.34	4.12	16.06	58.33	5.25
7	5.95	4.59	16.06	56.15	5.53
8	6.45	4.96	15.99	54.24	5.90
9	7.96	5.42	16.04	52.01	6.38
10	8.43	5.85	16.28	50.30	6.57
11	8.80	6.04	16.13	49.08	7.02
12	9.09	6.13	15.76	47.95	7.92
13	8.25	6.09	15.62	46.21	5.99
14	8.26	6.15	15.69	44.71	6.35
15	8.45	6.05	15.73	43.57	6.83
16	8.66	6.12	15.94	41.87	6.93
17	8.94	6.09	16.27	40.12	7.17
18	8.91	6.14	16.83	39.09	7.29
19	8.98	6.21	17.03	38.02	7.00
20	9.07	6.50	17.28	37.40	7.25
21	9.20	6.78	17.84	36.51	7.53
22	9.21	7.10	18.28	35.36	7.49
23	9.26	7.42	18.50	34.39	7.38
24	9.24	7.62	18.86	33.76	7.65

Source: Authors' elaborations using *VARsignR* package in *R* software

Table 3 shows the variance decomposition of all the five variables (i.e., *OG*, *WPI*, *REER*, *CMR* and *LGFD*) explained by fiscal policy shock (increase in fiscal deficit) after a period of twenty four months. The results depict that response of *WPI* to fiscal deficit shock is the highest to the tune of 31.83 percent among the remaining four variables after the self- explained variation in *LGFD* (46.33 percent). The second highest variation explained is in *CMR* (25.36 percent), followed by

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OG (23.25 percent) and *REER* (20.30 percent). Focusing on the comparison of shocks of both monetary and fiscal policies, it can be concluded that the fiscal policy shock (i.e., increase in fiscal deficit) has been explaining the higher variation in all the component variables than the monetary policy shock (i.e., reduction in interest rate).

Table 3 Variance Decomposition Due to a Fiscal Policy Shock (Fiscal Deficit Shock)

Period (Months)	Variables				
	OG	WPI	REEP	CMR	LGFD
1	2.58	7.61	3.17	8.49	62.29
2	3.09	8.02	3.57	8.85	60.29
3	3.75	8.54	4.04	9.20	58.26
4	4.34	9.26	4.32	9.57	56.28
5	4.77	9.84	4.92	9.79	54.23
6	7.27	10.86	5.63	10.52	53.48
7	8.85	11.56	6.82	11.71	52.12
8	9.87	12.12	8.18	12.86	50.16
9	11.61	13.05	8.82	13.92	48.88
10	12.52	14.33	9.75	14.90	48.24
11	13.11	16.47	10.68	15.84	48.15
12	14.07	20.10	12.62	16.39	46.71
13	13.45	22.71	14.18	17.47	51.14
14	14.59	25.34	15.49	18.07	50.25
15	15.41	27.03	16.29	18.99	49.05
16	15.99	28.58	16.82	20.12	48.59
17	16.72	29.79	17.08	21.31	47.74
18	18.31	31.02	17.83	22.36	47.77
19	18.99	31.82	18.39	23.19	48.10
20	19.97	32.21	18.63	23.71	47.22
21	21.45	32.19	19.44	24.00	46.76
22	22.09	32.05	19.94	24.52	46.80
23	22.67	31.82	20.24	25.10	46.54
24	23.25	31.83	20.30	25.36	46.33

Source: Authors' elaborations using *VARsignR* package in *R* software

Conclusion & Policy Implications

This paper is an endeavor to compare the effectiveness of monetary and fiscal policies from 2001:M4 to 2018:M7 in the context of India. The sign restricted VAR framework under Bayesian estimation technique has been preferred because: i) the simple VAR model takes into account only positive innovation to variables, that does not suite the exercise of expansionary monetary policy via reducing the rate of interest, ii) Bayesian VAR is free from the problems of non-stationarity, seasonality and structural break issues.

From the analysis, it has been noticed that fiscal policy causes higher variation than monetary policy in target variables

(output gap, price level and exchange rate). This reflects the fiscal dominance in the Indian economy. Innovation accounting analysis through impulse responses visualizes that both expansionary policies cause a significant impact on prices and exchange rate but the output gap gets significantly affected by monetary policy intervention only. Therefore, if all the three variables have to be targeted, monetary policy is observed to be better than fiscal policy in the Indian context.

Further, it has also been witnessed that fiscal authority though adjusts the expansionary monetary shock by marginally cutting down the fiscal deficit but it is statistically insignificant. However, response of monetary authority to any fiscal expansion is significant and an expansionary fiscal policy is generally responded by contractionary monetary policy (i.e., higher interest rate) by the RBI.

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